Refer to: Antoniskis A, Anderson BC, Van Volkinburg EJ, et al: Feasibility of outpatient self-administration of parenteral antibiotics. West J Med 128:203-206, Mar 1978

Feasibility of Outpatient Self-Administration of Parenteral Antibiotics

ANDRIS ANTONISKIS, MD; BRUCE C. ANDERSON, MD; EARL J. VAN VOLKINBURG, MD; JOANNE M. JACKSON, RN, MS, *and* DAVID N. GILBERT, MD, *Portland*

It is customary to treat patients with infective endocarditis or osteomyelitis for a prolonged period in hospital with parenteral antibiotics. It was felt that it might be feasible to allow parenteral administration of antibiotics by the patients themselves at home. Results in 13 patients who administered antibiotics parenterally themselves (experimental group) were compared with those in 7 patients (control group) treated entirely within the hospital. Antibiotic-related complications were similar in both groups. There was no instance of infection of the intravenous cannula in either group. The average daily cost of antibiotic therapy decreased from $243.22 for inpatients to $69.35 for outpatients. The average cost of illness was $6,357.22 in the experimental group and $10,022.23 in the control group. If patients are carefully selected and well educated, the outpatient self-administration of antibiotics parenterally is both economical and safe.

ACUTE HEMATOGENOUS OSTEOMYELITIS and bacterial endocarditis are serious infectious diseases for which up to six weeks of therapy with parenterally administered antibiotics is recommended.[1-3] It is often difficult for patients or their physicians to accept the long hospital stays and the resulting high cost. In addition, many patients feel well after one to two weeks of therapy and become frustrated with a continuing requirement to remain in a hospital. It seemed feasible, therefore, to discharge these patients and have them continue their parenteral antimicrobic therapy at home with proper education and supervision. This report describes our experience using this procedure with 13 patients.

Methods

The clinical records of one of the authors (DNG), an infectious diseases consultant, were reviewed for the years 1971 through 1976. During this time, 20 patients received parenterally given antibiotics for several weeks for either acute osteomyelitis or bacterial endocarditis. Thirteen patients received a portion of their therapy as outpatients and were considered the experimental group; seven patients were treated entirely within the hospital and were considered the control group.

All 13 patients in the experimental group had a serious infectious disease process requiring parenterally given antibiotics, and the skill and intelligence to administer antibiotics at home. All agreed to comply with the specifications of outpatient administration and follow-up. All patients were in the hospital for initial diagnosis and treatment. Diagnoses in all patients were confirmed bacteriologically in the hospital's microbiology laboratory. No patient was considered a candidate for the outpatient use of parenteral antibiotics until the infectious process had responded clinically to treatment, and the patient was afebrile for at least five days. Then the patient and at least one family member were instructed by the hospital IV Department in (1) aseptic technique during antibiotic preparation and administration, (2) adverse reactions to the

From the Leslie Gilbert Infectious Diseases Research Laboratory, Providence Medical Center and the Department of Medicine, University of Oregon Health Sciences Center, Portland.

Submitted, revised, September 9, 1977.

Reprint requests to: David N. Gilbert, MD, Providence Medical Center, 700 NE 47th Ave., Portland, OR 97213.

prescribed drug, (3) complications of the intravenous (IV) cannula and (4) the mechanics of IV antibiotic administration. Before discharge from the hospital the patients and participating family members were required to demonstrate their sterile technique in front of a member of the Infectious Diseases group. Patients were required to return to the IV Department every three days for insertion of a new IV cannula and to obtain fresh supplies. The patients were seen by their attending physician (DNG) at least once a week. Patients were instructed to return to the hospital emergency room if any immediate problems arose.

All intravenously given antibiotics were administered through a capped heparin-lock percutaneous forearm IV cannula. All patients were instructed to limit their activities during the treatment period to those that could be conducted within their residences.

Clinical and financial data were obtained from many sources, including hospital and physicians' medical records, records of the infectious diseases consultant (DNG), patient interviews and the hospital's business office records.

Results

Experimental Treatment Group

The bacteriologic and clinical diagnoses of the 13 patients are reviewed in Table 1. The group consisted of five females and eight males ranging in age from 12 to 61. In five patients the diagnosis was acute osteomyelitis, four cases due to Staphylococcus aureus and one due to Escherichia coli. In six patients the diagnosis was chronic osteomyelitis, five due to S. aureus and one due to Citrobacter species. The five chronic osteomyelitis patients were treated aggressively with a combination of surgical debridement and antibiotics for localized disease with sequestra. One patient was treated for S. aureus bacteremia and the last patient had Staphylococcus epidermidis endocarditis.

The outpatient antibiotic treatment regimens and complications are summarized in Table 2. As shown, a variety of antimicrobials were administered. In two patients, the development of hemorrhagic cystitis necessitated a change from methicillin to cephalothin. There was considerable variability in the duration of hospital treatment before beginning supervised outpatient drug use. However, the mean number of inpatient treatment days was 22. The duration of outpatient antibiotic administration ranged from 2 to 32 days with a mean of 21 days. Therefore, on the average, the duration of inpatient treatment and outpatient treatment was equivalent.

Four antibiotic-related complications occurred during the outpatient drug treatment (Table 2). In two patients methicillin hemorrhagic cystitis developed (reported in detail elsewhere).[4] In one patient treated with gentamicin, evidence of vestibular damage developed despite normal peak serum concentrations. One patient had complaint of diaphoresis and chills after each dose of penicillin G. It is of interest that two additional antibiotic-related complications occurred during treatment in hospital. In case 2 neutropenia developed, believed due to nafcillin. In case 8 a symptom complex of headache, myalgia, paresthesias and eosinophilia developed, attributed to cephalothin. Therefore, in the entire group there were two antibiotic adverse reactions during inpatient treatment and four adverse reactions during outpatient treatment.

All patients who suffered adverse drug reactions were successfully given alternative anti-

TABLE 1.—*Experimental Group: Diagnoses and Results of Therapy*

Case	*Age/Sex*	*Diagnosis*	*Duration of Followup and Outcome*
1. . .	51 F	Staphylococcus aureus acute osteomyelitis	No recurrence after 8 months
2. . .	15 M	S. aureus chronic osteomyelitis	No recurrence after 28 months
3. . .	28 M	S. aureus chronic osteomyelitis	Lost to follow-up
4. . .	45 F	S. aureus chronic osteomyelitis	Recurrence after 4 months
5. . .	23 F	S. aureus acute osteomyelitis	No recurrence after 9 months
6. . .	12 M	S. aureus bacteremia	No recurrence after 36 months
7. . .	46 F	Citrobacter species chronic osteomyelitis	Recurrence after 8 months
8. . .	21 M	S. aureus chronic osteomyelitis	No recurrence after 12 months
9. . .	47 M	Escherichia coli acute osteomyelitis	No recurrence after 10 months
10. . .	37 M	S. aureus chronic osteomyelitis	No recurrence after 18 months
11. . .	45 M	S. aureus acute osteomyelitis	Recurrence after 2 months
12. . .	52 M	S. aureus and several Gram-negative organisms, acute osteomyelitis	No recurrence after 17 months
13. . .	61 M	Staphylococcus epidermidis subacute bacterial endocarditis	No recurrence after 13 months

biotics without incident. None of the four patients in whom adverse drug reactions developed during outpatient treatment required readmission to the hospital.

For reasons other than adverse reactions, three patients did require readmission to complete their prescribed course of outpatient drug administration. Two patients had increasingly more frequent IV cannula changes because of venous thrombi and a resulting lack of superficial veins. The third patient, a 15-year-old boy, was readmitted after only two days because his mother found it difficult to cope emotionally with the responsibility of outpatient antibiotic administration. The remaining ten patients had no major difficulties in preparing and administering antibiotics at home. Despite the recommendation that cannulas be replaced every three days, cannula replacement varied from once a day to every five days. Despite this variability, there no cannula site infections.[5-7] None of the patients complained about having to return frequently for cannula replacement; they accepted this inconvenience in order to remain outside the hospital.

Control Treatment Group

The bacteriologic and clinical diagnoses of the seven control patients are reviewed in Table 3. The group consisted of four males and three females with ages ranging from 12 to 72. All patients had osteomyelitis, four due to S. aureus, two due to Pseudomonas aeruginosa and one due to Serratia marcescens.

For a variety of reasons, none of these patients was a candidate for parenteral antibiotic therapy at home. Two patients had impaired mental faculties, four patients were severely immobilized by their other orthopedic therapy (for example, bilateral long leg casts in traction) and one patient could not speak English. Furthermore, three of the seven patients were receiving Medicare medical benefits in the hospital, but Medicare denied reimbursement for the same drugs self-administered as outpatients.

Three patients received a combination of gentamicin and carbenicillin therapy. Two patients were given methicillin, and cephalothin was prescribed for one patient. In one patient receiving cephalothin a skin exanthem developed, in a second patient receiving cephalothin there was a profound neutropenia, and in a third patient methicillin hemorrhagic cystitis developed.[4]

Cost of Parenteral Antibiotics

Cost factors for the inpatient and outpatient use of antibiotics were identified. For patients

TABLE 2.—*Outpatient Antibiotic Treatment: Duration and Complications*

Case	Antibiotic Dose/Day, Route	Days of Treatment		Complications
		Inpatient	Outpatient	
1. . .	Methicillin, 12 grams IV; then cephalothin, 12 grams IV	28	19	Hemorrhagic cystitis
2. . .	Nafcillin, 12 grams IV	41	2	None
3. . .	Penicillin G, 12 mil U IV	15	6	None
4. . .	Cefazolin, 6 grams IV	15	8	None
5. . .	Methicillin, 12 grams IV; then cephalothin, 12 grams IV	14	32	Hemorrhagic cystitis
6. . .	Vancomycin, 2 grams IV	25	11	None
7. . .	Gentamicin, 180 mg IM	9	30	Vestibular damage
8. . .	Cephalothin, 12 grams IV	16	16	None
9. . .	Cephalothin, 12 grams IV	27	21	None
10. . .	Penicillin G, 1.2 mil U IV	21	28	Post-infusion chills, diaphoresis
11. . .	Methicillin, 18 grams IV	11	29	None
12. . .	Ampicillin, 12 grams IV	39	6	None
13. . .	Cephalothin, 12 grams IV	21	21	None

IM = intramuscular IV = intravenous

TABLE 3.—*Control Group: Diagnoses and Results of Therapy*

Case	Age/Sex	Diagnosis	Results of Therapy
1.	72 M	Pseudomonas aeruginosa osteomyelitis	No recurrence after 48 months
2.	67 M	Serratia marcescens osteomyelitis	Recurrence after 10 months
3.	38 F	Staphylococcus aureus osteomyelitis	No recurrence after 36 months
4.	43 M	S. aureus osteomyelitis	No recurrence after 26 months
5.	74 F	S. aureus osteomyelitis	No recurrence after 18 months
6.	12 M	P. aeruginosa osteomyelitis	No recurrence after 12 months
7.	63 F	S. aureus osteomyelitis	No recurrence after 24 months

TABLE 4. *Results of Cost Analysis in Experimental and Control Patients*

	Experimental Group		Control Group
	Inpatient	Outpatient	All Inpatient
Average cost per day	$234.22	$69.35	$229.70
Average cost of illness	$6,357.52		$10,022.23

in hospital, daily costs were accrued for the hospital room, the antibiotic, IV tubing, dextrose solution, heparin flushes, the nurse administration fee and a daily physician's fee. For outpatients, daily cost factors included the cost of the drug, heparin flushes and other supplies for IV drug use. A weekly physician fee was used in calculation of outpatient costs. All costs were calculated on the basis of 1977 prices.

The results of the cost analysis are shown in Table 4. The average inpatient cost per day was similar for both the experimental and control groups. As anticipated, there was a dramatic reduction from $234.22 to $69.35 in the average daily cost when the drugs were given out of the hospital. For inpatients, the components of the total daily cost were as follows: room charge, 50 percent; antibiotic cost, 19 percent; dextrose solution and heparin flush costs, 24 percent; physician fee, 5 percent, and IV nurse administration fee 2 percent. Therefore, the major savings were in room costs, and to a much lesser degree in physician's fees. Comparing the average cost of illness for the two groups, an average saving of $3,700 per patient was achieved.

Discussion

The results of our experience support the feasibility of allowing patients to self-administer parenteral antibiotics with family assistance, thereby achieving easily measurable savings in expenses. Our major concern was, and continues to be, the potential hazards of such a program.[5-7] Our experience suggests that outpatient parenteral antibiotic self-administration is no more dangerous, and no less efficacious, than inpatient nurse-administered parenteral antibiotics—provided patient selection and education are appropriate. Six adverse antibiotic reactions occurred in the 13 patients of the experimental group. Two complications occurred during inpatient antibiotic administration and four occurred during outpatient antibiotic administration. There is nothing to suggest that treatment in hospital would have prevented the four outpatient antibiotic complications.

Several other points deserve emphasis. No patients required readmission because of drug toxicity. An occasional patient was unable to complete outpatient therapy because of paucity of veins or emotional problems with needles. However, there were no instances of a technical inability to mix the drug, connect tubing or insert needle into heparin lock. There were no instances of air emboli. There were no life-threatening antibiotic reactions. We believe our success is due largely to the extensive education program each patient received before leaving the hospital.

All patients were instructed to return to the hospital promptly if any problem, regardless of its seriousness, occurred. It is essential that good communication be maintained among the patient, the physician and all involved hospital departments. In our hospital letters of instruction explaining the patient's special status were sent to the hospital pharmacy, IV Department, and Emergency Department at the time of discharge.

Assuming that prolonged parenteral therapy does result in fewer relapses and is therefore desirable, it is likely that many patients are denied prolonged treatment because of either the expense or the confining nature of prolonged hospital stays. Therefore, outpatient parenteral antibiotic self-administration allows patients to have a more normal life, saves money, appears to be safe and may contribute to a better clinical result.

Unfortunately, the regulations of many health insurance carriers provide only partial or no reimbursement for the cost of outpatient medication. Several smaller insurance companies have honored such claims after the inherent dollar savings were explained. Despite extensive documentation of dollar savings, to date both Medicare and Blue Cross have not altered their regulations regarding this special use of outpatient drugs.

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